

## PART 1 - GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.42	(1995) Electric Lamps - Guideline for high-pressure Sodium Lamps
ANSI C78.1375	(1996) Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1378	(1996) Electric Lamps - 250-Watt M58 Single-Ended Metal-Halide Lamps
ANSI C78.1381	(1989; R 1997) Electric Lamps - 70-Watt M85 Metal-Halide Lamps
ANSI C78.1382	(1996) Electric Lamps - 100-Watt M90 Single-Ended Metal-Halide Lamps
ANSI C78.1384	(1997) Electric Lamps - 150-Watt M102 Single-Ended Metal-Halide Lamps
ANSI C82.1	(1997) Electric Lamp Ballast – Line Frequency Fluorescent Lamp Ballast
ANSI C82.2	(1984; R 1995) Fluorescent Lamp Ballasts - Methods of Measurement
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C82.11	(1993; R 1998) High-Frequency Fluorescent Lamp Ballasts

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1997) Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled
ASTM A 580/A 580M	(1998; Rev. A) Stainless Steel Wire
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 633 (1998) Electrodeposited Coatings of zinc on Iron and Steel

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK (1993) Lighting Handbook, Reference and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA LL 1 (1997) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

NFPA 101 (1997) Life Safety Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 20 (1995; R 1998) General-Use Snap Switches

UL 773 (1995; R 1998) Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A (1995; R 1998) Nonindustrial Photoelectric Switches for Lighting Control

UL 924 (1995; R 1997, Bul. 1998) Emergency Lighting and Power Equipment

UL 935 (1995; R 1998) Fluorescent-Lamp Ballasts

UL 1029 (1994; R 1997) High-Intensity-Discharge Lamp Ballasts

UL 1570 (1995; R 1999) Fluorescent Lighting Fixtures

UL 1572 (1995; R 1999) High Intensity Discharge Lighting Fixtures

## 1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Distribution System."

## 1.3 DEFINITIONS

### 1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

### 1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

## 1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

### 1.4.1 SD-01, Product Data

- a. Fluorescent lighting fixtures
- b. Fluorescent electronic ballasts
- c. Fluorescent lamps
- d. High-intensity-discharge (HID) lighting fixtures
- e. HID ballasts
- f. High-pressure sodium (HPS) lamps
- g. Metal-halide lamps
- h. Lighting contactor
- i. Time switch
- j. Photocell switch
- k. Exit signs
- l. Emergency lighting equipment
- m. Occupancy sensors
- n. Aluminum Poles.

#### 1.4.2 SD-03, Test Reports

- a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

#### 1.4.3 SD-04, Operation and Maintenance Data

- a. Lighting Control System, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein, showing all control modules, control zones, occupancy sensors, light fixtures, and all interconnecting control wire, conduit, and associated hardware.

#### 1.4.4 SD-05, Closeout Submittals

- a. Information card

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein.

#### 1.5.2 Lighting Control System

Submit operation and maintenance manuals for lighting control systems that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. This shall include:

- a. Schematic diagram of the lighting control system.
- b. Manufacturers' operating and maintenance manuals on active lighting control equipment. Lighting control equipment shall include, if indicated: occupancy sensors, power packs, dimming ballasts, and light level sensors.

### 1.6 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

## PART 2 - PRODUCTS

### 2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

#### 2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall be UL listed Class P with a sound rating of "A."

f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

g. Ballast shall operate in an instant start mode.

h. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

##### 2.1.1.1 T-8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 10 degrees C 50 degrees F for F32T8 lamps, unless otherwise indicated. When indicated, ballast shall be capable of starting and maintaining operation at a minimum of minus 17 degrees C zero degrees F for F32T8 lamps.

b. Total harmonic distortion (THD): Shall be 10 percent (maximum).

c. Input wattage.

(1) 32 watts (maximum) when operating one F32T8 lamp.

(2) 62 watts (maximum) when operating two F32T8 lamps

(3) 92 watts (maximum) when operating three F32T8 lamps

(4) 114 watts (maximum) when operating four F32T8 lamps

d. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

#### 2.1.1.2 F17T8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 10 degrees C 50 degrees F for F17T8 lamps, unless otherwise indicated.

b. Total harmonic distortion (THD): Shall be 25 percent (maximum).

c. Input wattage: 34 watts (maximum) when operating two F17T8 lamps.

#### 2.1.2 Fluorescent Lamp Electronic Dimming Ballast

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C62.11, and NFPA 70, unless specified otherwise. Ballast dimming capability range shall be from 100 to 10 percent (minimum range) of light output, flicker free. Ballast shall start lamp at any preset light output setting. When power is applied, ballast shall not ramp up to full light output and then dim to preset level. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

e. Ballast shall be UL listed Class P with a sound rating of "A".

f. Ballast shall have circuit diagrams and lamp connections displayed on the ballast. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

g. Ballast shall operate in a rapid start mode.

h. Ballast shall be capable of starting and maintaining operation at a minimum of 10 degrees C 50 degrees F for F32TB lamps, unless otherwise indicated.

i. Total harmonic distortion (THD): Shall be 20 percent (maximum) over the entire dimming range.

#### 2.1.3 Dimming Ballast Controls

The dimming ballast controls shall be a slide dimmer with on/off control. The slide dimmer shall be compatible with the ballast and control the ballast light output over the full dimming range.

#### 2.1.4 Fluorescent Lamps

a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

b. T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

c. T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), 3500 K, 75 CRI (minimum), 20,000 hours average rated life, 1.625 inch leg spacing.

d. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

Average rated life is based on 3 hours operating per start.

#### 2.1.5 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated.

#### 2.1.6 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp).

#### 2.1.7 Air Handling Fixtures

Fixtures used as air handling registers shall meet requirements of NFPA 90A.

### 2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572. Provide HID fixtures with tempered glass lenses when using metalhalide lamps.

#### 2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

- a. Designed to operate on the voltage system to which they are connected.
- b. Designed for installation in a normal ambient temperature of 40 degrees C.
- c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

### 2.2.2 High-Pressure Sodium (HPS) Lamps

ANSI C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type.

### 2.2.3 Metal-Halide Lamps

- a. 70 watt conforming to ANSI C78.1381
- b. 100 watt conforming to ANSI C78.1382
- c. 150 watt conforming to ANSI C78.1384
- d. 175 watt conforming to ANSI C78.1377
- e. 250 watt conforming to ANSI C78.1378
- f. 400 watt conforming to ANSI C78.1375
- g. 1000 watt conforming to ANSI C78.1376

## 2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

## 2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.

## 2.5 LIGHTING CONTACTOR

NEMA ICS 2, electrically operated, mechanically held contactor. Rate contactor as indicated. Provide in enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor. Provide contactor with accessories indicated.

## 2.6 TIME SWITCH

Astronomic electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated as indicated, with battery backup to retain memory during loss of normal power. Battery life shall be at least 5 years. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be factory furnished or as indicated conforming to NEMA ICS 6.

## 2.7 PHOTOCCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated as indicated with single-throw contacts. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch in a U.V. stabilized polycarbonate



housing with swivel arm and adjustable window slide, or in a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

## 2.8 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type.

### 2.8.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum).

## 2.9 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101.

### 2.9.1 Fluorescent Emergency System

Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture or behind the lens, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to one or two lamps for 90 minutes at an initial minimum of 1350 lumens output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts which are provided with fixtures containing solid-state ballasts shall be suitable for use with solid-state ballasts.

### 2.10 SELF-TESTING MODULE

Self-testing module for exit signs shall perform the following functions:

- a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.
- b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.
- c. Manual test switch to simulate a discharge test cycle.
- d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

### 2.11 OCCUPANCY SENSORS

Occupancy sensor: Dual Technology, Ultrasonic/Infrared Occupancy Sensors, wide angle, low voltage controller. Adjustable time delay of 15 seconds to 30 minutes to turn lights off. Light level sensor adjustable from 2 to 200 footcandles. Two LED detection indicators. Coverage up to 2000 square feet. With power supply and contacts rated 277V, 20A, as required. The Watt Stopper, Inc. (no substitutions).

## 2.12 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

### 2.12.1 Wires

ASTM A 641/A 641M, Class 3, soft temper, zinc-coated finish, 0.1055 inches in diameter (12 gage).

### 2.12.2 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

## 2.13 POLES

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS3 while supporting luminaires having effective projected areas indicated. Poles shall be anchor-base type designed for use with underground supply conductors. Poles, shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws.

### 2.13.1 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS2 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for aluminum poles shall be cast from 356-T6 aluminum alloy in accordance with ASTM B 108.

## 2.14 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03300, "Cast-In-Place Concrete."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires are provided at a minimum of four wires per fixture and located not more than 6 inches from each corner of each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture and locate at each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees. Provide wires for lighting fixture support in this section.

### 3.1.1 Electronic Dimming Ballast

All electronic dimming ballasts controlled by the same controller shall be of the same manufacturer. All fluorescent lamps on electronic dimming ballast control shall be seasoned or burned in at full light output for 100 hours before dimming.

### 3.1.2 Exit Signs and Emergency Lighting Units

Wire exit signs ahead of the switch to the normal lighting circuit located in the same room or area. Wire emergency ballasts in fluorescent fixtures to allow the fixture to be switched normally with other fixtures in the space, but to monitor the normal power and switch on under battery power when normal power fails.

### 3.1.3 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Set adjustable window slide for minimum footcandles photocell turn-on.

### 3.1.4 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum, provide additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) on the ceiling as indicated and in accordance with the manufacturer's recommendations to maximize energy savings to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 15 minutes.

## 3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

### 3.2.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

### 3.2.2 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

END OF SECTION